DECAPOD CRUSTACEAN LARVAE COLLECTED DURING THE INTERNATIONAL INDIAN OCEAN EXPEDITION. FAMILIES RANINIDAE AND HOMOLIDAE

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By A. L. RICE

SYNOPSIS

Five crustacean larvae belonging to the family Raninidae and two belonging to the family Homolidae are described from material collected during the International Indian Ocean expedition. Probable identities of the larvae are suggested where possible. Larval evidence for the relationship between the Homolidae, the Raninidae and the higher Brachyura is discussed.

INTRODUCTION

THE larval stages of decapod crustaceans of the Indian Ocean are rather poorly known, few having been hatched from the adults and even fewer reared through all the larval stages. Consequently, only a very small proportion of larvae taken in the plankton in this region can be identified to species with any certainty, and in many cases identification even to family is difficult.

In those decapodan families in which the larval characteristics are already well known an account of plankton caught material of unknown specific or even generic identity is of doubtful value. On the other hand, the larvae of some families are so poorly known that any information on the developmental stages is of value, even if the material on which this information is based is at the moment unidentifiable. Such is the case with the crab-like families Raninidae and Homolidae, and although the I.I.O.E. collections contain very little material of either group a report on it is warranted.

Family **RANINIDAE**

Larval stages belonging to some ten species of raninids have been described previously, but in only three cases have the larvae been definitely identified with a known adult. *Ranina ranina* (L.) larvae were hatched from the egg by Aikawa (1941) and the first stage described. *Lyreidus tridentatus* de Haan larvae were reared from the egg to the moult from the 5th to the 6th (last) zoeal stage by Williamson (1965) who also had plankton caught megalopae which moulted in the laboratory to the first young crab stage. Finally, Knight (1968) reared larvae of *Raninoides benedicti* Rathbun taken from the plankton off the Pacific coast of Mexico, some specimens collected as first zoeae surviving into the early crab stages.

Two of the above species, *R. ranina* and *L. tridentatus*, have been recorded as adults from the Indian Ocean, but the larvae of the other eight recorded Indian

TABLE 1

Indian Ocean records of adult raninid crabs

Species	Locality	Source
Cosmonotus grayi Adams and White	Persian Gulf	Alcock, 1896
	Dar-es-Salaam	Doflein, 1904
	Holothuria Bank, 13° 35′S: 126°E	British Museum (Nat. Hist.)
Lyreidus channeri Wood-Mason	Bay of Bengal, 21° 6′30″N: 89° 20′E	Wood-Mason, 1886
	Bay of Bengal, 9° 14′10″N: 75° 46′E	Alcock, 1899
	Bay of Bengal	Alcock, 1896
	Andaman Sea	Alcock, 1896
	"Both sides of Ceylon"	Alcock, 1896
	Malabar Coast	Alcock, 1896
Lyreidus tridentatus de Haan	Dar-es-Sallaam	Doflein, 1904
	N.E. Laurenco Marques, Mozambique, 25° 32′S: 33° 24′E	U.S. Nat. Mus.
Notopus dorsipes (Fabr.)	Malabar Coast	Alcock, 1896
	Andamans	Alcock, 1896
	Zanzibar	Nobili, 1905
	Mauritius	Studer, 1882
Notosceles chimmonis Bourne	Amirante Islands	U.S. Nat. Mus.
	Seychelle Islands	U.S. Nat. Mus.
Notosceles viaderi Ward	Mauritius	Ward, 1942
Ranina ranina (L.)	Durban	Barnard, 1950
	Delagoa Bay	Barnard, 1950
	Zululand Coast	Barnard, 1950
	Mozambique Channel, 19° 5′S: 36° 21′E	U.S. Nat. Mus.
	Mozambique	Bianconi, 1851
	Mauritius	Bouvier, 1915
	Reunion	Hoffman, 1874
Raninoides hendersoni Chopra	Andaman Sea, 11° 49′50″N: 92° 52′E	Chopra, 1933b
Raninoides personatus White	Bay of Bengal, off the mouth of the river Hughli	Chopra, 1933a
	Bay of Bengal	Alcock, 1896
Raninoides serratifrons Henderson	Holothuria Bank	Henderson, 1893
	Off Cape Negrais, Burma 15° 25′N: 93° 45′E	Zool. Survey India
	Off Travancore coast, 9° 55′N: 75° 45′E	Zool. Survey India
	Off southern Ceylon, 6° 2′3″N: 81° 29′E	Zool. Survey India
	Ceylon	Laurie, 1906
	Ceylon	Alcock, 1896
	Malabar Coast	Alcock, 1896
	Port Shepstone, Natal	Barnard, 1950

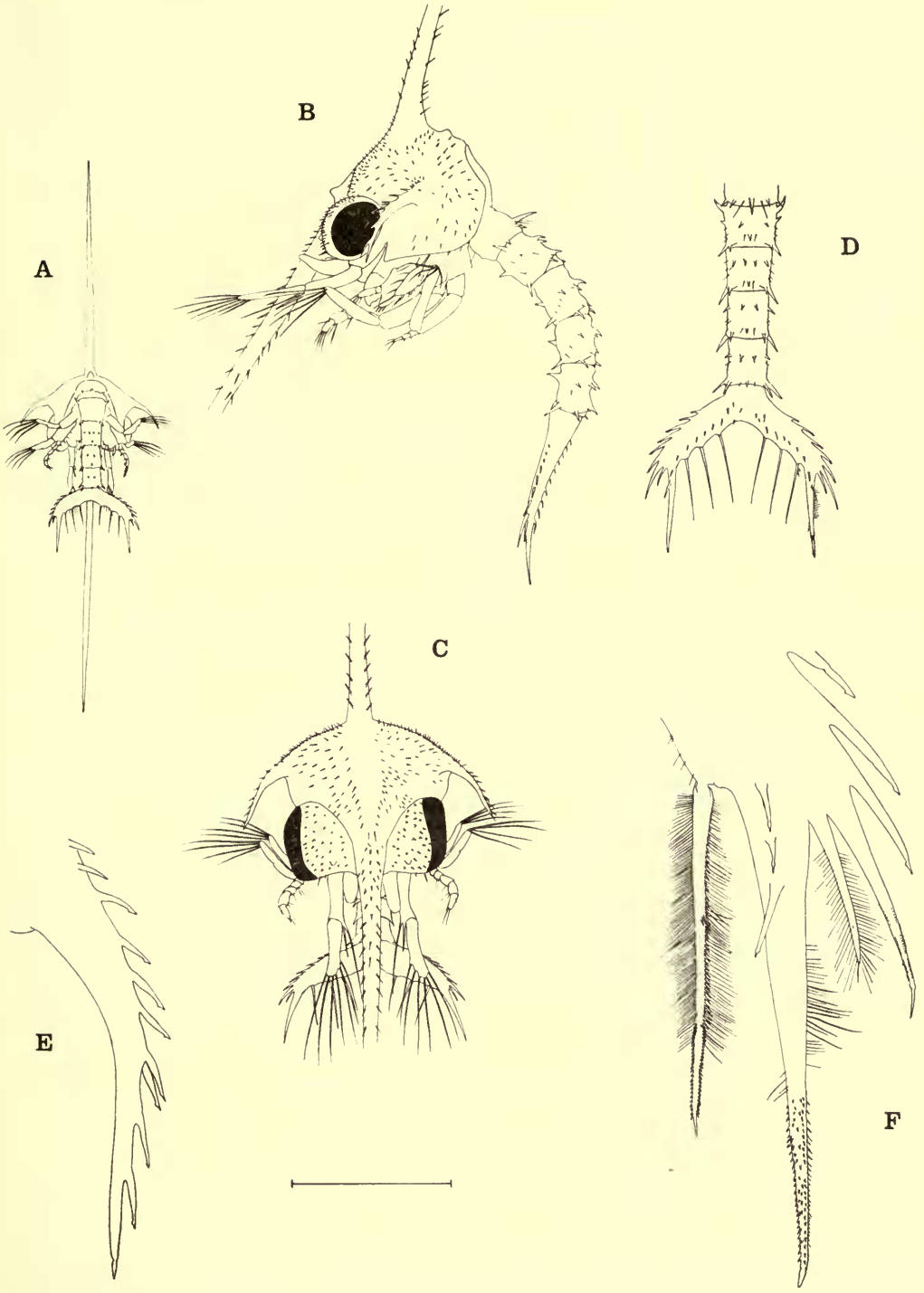

FIG. 1. *Ranina ranina* (L.), stage I zoea. *A*, Posterior view; *B*, lateral view; *C*, frontal view; *D*, dorsal view of abdomen; *E*, enlarged frontal view of lateral carapace spine of left-hand side; *F*, enlarged dorsal view of postero-lateral part of telson. Bar scale represents 2.0 mm for *A*, 1.0 mm for *B*, *C* and *D*, and 0.2 mm for *E* and *F*.

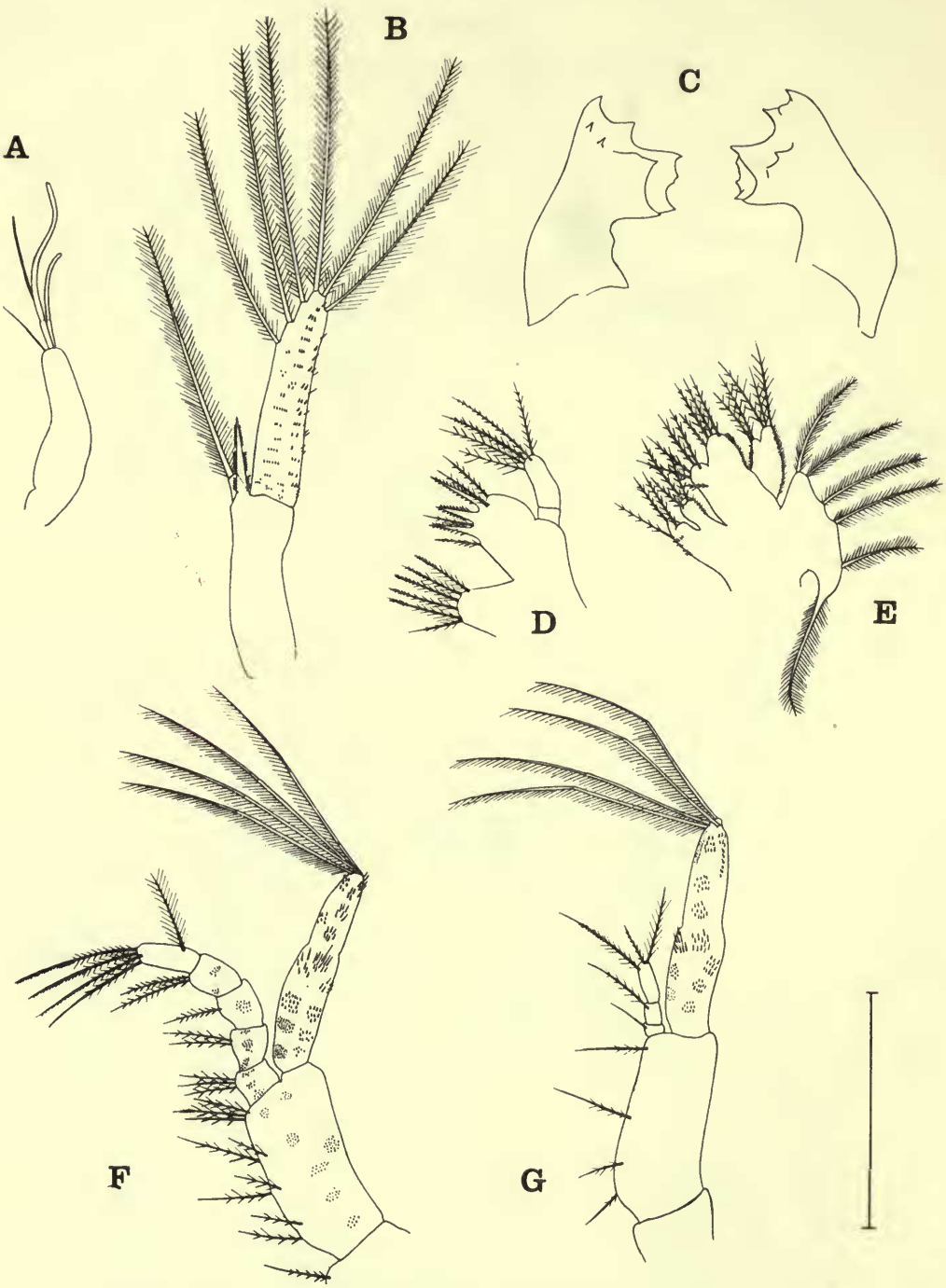

FIG. 2. *Ranina ranina* (L.), stage I zoea. *A*, Antennule; *B*, antenna; *C*, mandibles; *D*, maxillule; *E*, maxilla; *F*, first maxilliped; *G*, second maxilliped. Bar scale represents 0·5 mm.

Ocean raninids (see Table 1) are completely unknown. The I.I.O.E. collections contain only four raninid zoeae and a single megalopa. One of these zoeae apparently belongs to *R. ranina* but the identities of the other specimens are very uncertain.

The British Museum (Natural History) collections contain hatched material of *R. ranina* and I have taken this opportunity to re-illustrate the first zoea of this species.

Ranina ranina (L.)

(figs 1 and 2)

Aikawa, 1941, pp. 117–118, fig. 1.

MATERIAL: (a) About 100 stage 1 zoeae hatched in the Aquarium de Nouméa, New Caledonia, 4. XII. 1956 and presented to the British Museum (Natural History) by Mons. P. Budker of the Museum National d'Histoire Naturelle, Paris (B.M. reg. no. 1958: 7: 4: 2–9).

(b) One stage 1 zoea taken by the *Anton Bruun* at station 18, 07° 41′N: 97° 59′E on 21. III. 1963. This specimen is badly damaged but appears to belong to this species.

SIZE: Tip to tip of the rostral and dorsal carapace spines 6·7–7·7 mm.

REMARKS: Because of the relative abundance of material available it is now possible to illustrate the larvae of this species adequately and a written description is not necessary.

Aikawa's Japanese larvae were somewhat smaller than those from Nouméa and he gives a spine tip to spine tip length of 4·2 mm, but the two sets of larvae show very close agreement in all other features which Aikawa either described or illustrated.

However, Aikawa did not mention the spinules on the antennae and maxillipeds although they were almost certainly present in his material. Williamson (1965) reported such spines on the maxillipeds of first stage zoeae of *Lyreidus tridentatus*, and these features may therefore be widespread within the Raninidae. However, without dissection the appendages of the larvae reported below could not be examined at sufficiently high magnifications in all cases to determine whether the spinules are present or not.

Raninid larva A; ?Raninoides sp.

(fig. 3)

MATERIAL: One specimen in the first zoeal stage. Position 12° 36′N: 80° 40′E; depth 200 m to surface. Date 20. VI. 1964. Vessel I.N.S. *Kistna;* Station 378. I.O.B.C. serial no. 0612.

SIZE: Tip to tip of the rostral and dorsal carapace spines 3·3 mm; Carapace length from between eyes to postero-lateral carapace margin 0·93 mm.

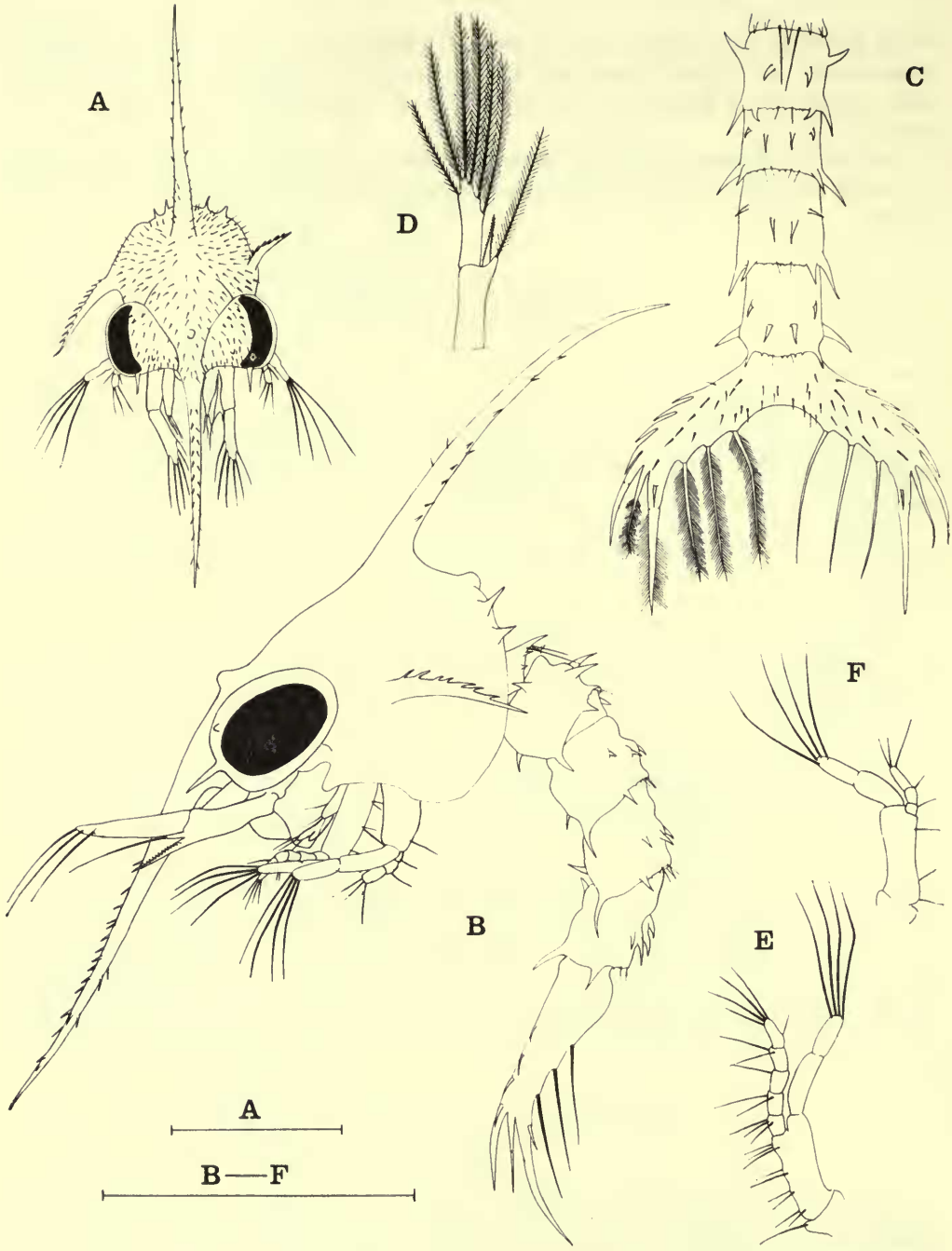

FIG. 3. Raninid larva A, stage I zoea. *A*, Frontal view; *B*, lateral view; *C*, dorsal view of abdomen; *D*, antenna; *E*, first maxilliped; *F*, second maxilliped. The setae covering the surface of the carapace and abdomen are omitted from *B* and *C* for clarity. Bar scales represent 1.0 mm

DESCRIPTION: Carapace with prominent, curved, dorsal and rostral carapace spines, each with a number of subsidiary spines, mainly on the anterior edge of the rostral spine and the posterior edge of the dorsal spine. Lateral spines normally directed downward and forward, roughly parallel to the rostral spine, but that of the left-hand-side displaced backwards (see fig. 3). Each lateral spine with a row of subsidiary spines on the dorsal edge. Anterior dorsal tubercle in the mid-line between eyes; posterior tubercle behind the dorsal spine. A pair of spines on each side of the posterior carapace tubercle, close to the posterior carapace margin. Surface of carapace covered with stiff, almost spine-like bristles (not shown in fig. 3(B)). Eyes sessile, each with a proment spine and a papilla on the stalk.

Abdomen of 5 segments plus the telson. Segment 1 with a large mid-dorsal spine and 2 pairs of smaller dorso-lateral spines. Segments 2–5 each with a single median ventral spine and paired dorsal, dorso-lateral, postero-lateral and postero-ventral spines. The dorso-lateral spines on segment 2 directed forwards like the 'lateral knobs' on this segment in the larvae of the higher Brachyura.

Telson (fig. 3(C)). Each arm of the shallow telson fork with a very large setose spine and 3 postero-median plumed setae. Outside the major spine on each side there are 2 spines, the outer naked, the inner setose. Antero-lateral margin of each telson arm carries 4 smooth spines. There are a number of spinules on the dorsal surface of the telson, and each of the 2 major spines has a subsidiary spine on the dorsal surface close to the base.

Antennule simple and unsegmented, with 2–3 terminal aesthetascs and 1 seta.

Antenna as shown in fig. 3 (D).

Mandibles with incisor and molar processes, but no palp.

Maxillule with an unsegmented endopod with 3 terminal and 1 sub-terminal seta. Endites well developed, but no lateral seta on basis.

Maxilla with 5 setae on the endopod. Scaphognathite with 4 sub-equal plumose setae on the lateral margin and a much longer posterior seta.

Maxillipeds 1 and 2 as shown in fig. 3 (E and F).

None of the more posterior appendages developed.

REMARKS: This larva is tentatively attributed to the genus *Raninoides*, on the basis of its close resemblance to that of *Raninoides benedicti*, but it could belong to other Indian Ocean genera whose larvae are unknown. It differs so much from the first zoea of *Lyreidus tridentatus*, particularly in the length of the lateral carapace spines and in the form of the telson, that it is very unlikely to belong to *L. channeri*, the only other member of the genus recorded from the Indian Ocean. The larva also differs from the *Ranina ranina* larvae illustrated above, particularly in being much smaller and possessing eyestalk spines.

Of the raninids recorded from the Indian Ocean this leaves 7 species belonging to the genera *Cosmonotus*, *Notopus*, *Notosceles* and *Raninoides* as possible parents. The larva could belong to any of these genera, but its very close resemblance to the described larvae of *Raninoides benedicti* Rathbun (Knight, 1968) makes another species of this genus a strong possiblity.

The larva differs from the first stage of *R. benedicti* in only a few relatively minor points. Thus, the lateral carapace spines are relatively longer than in *R. benedicti*

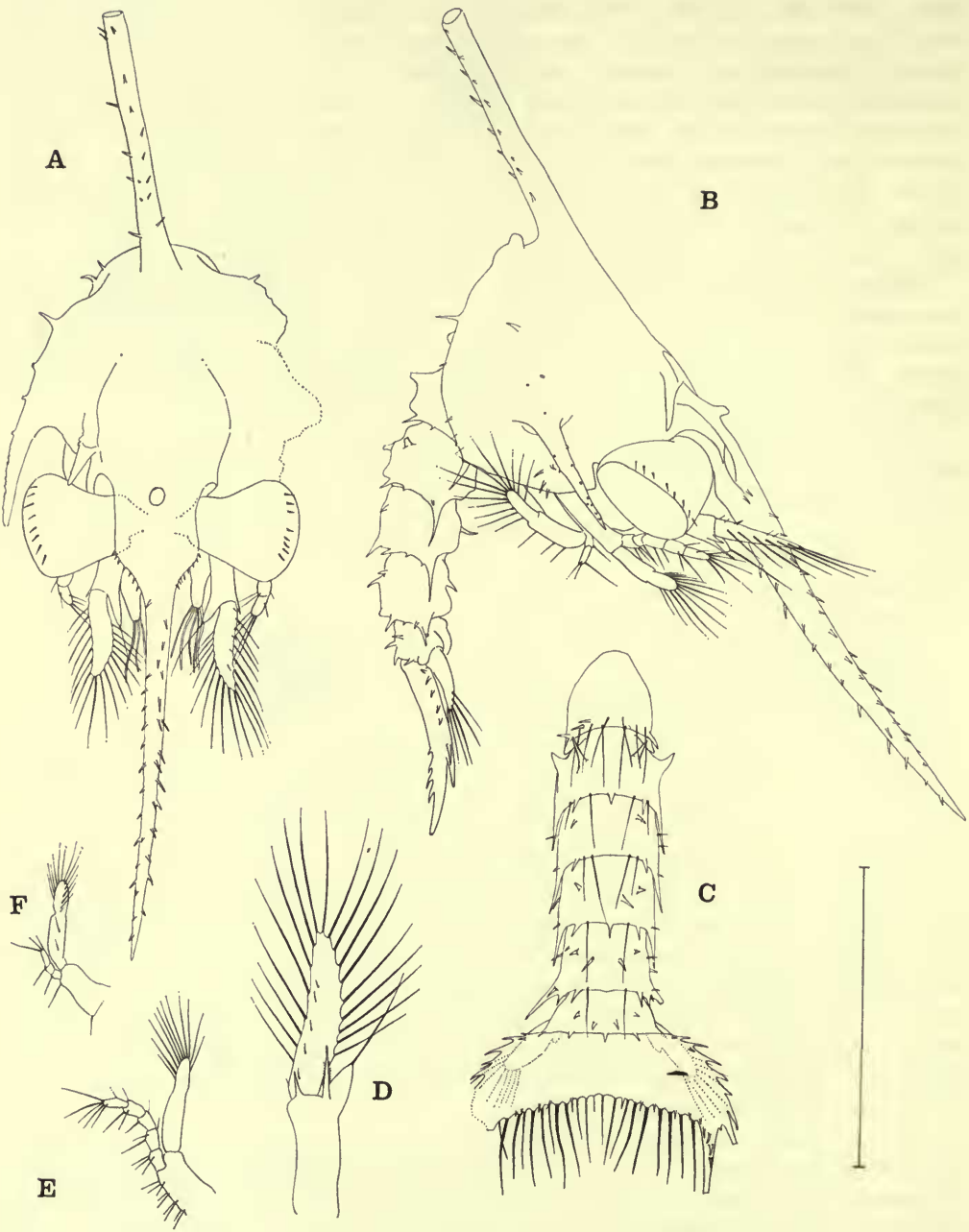

FIG. 4. Raninid larva B, stage III (?) zoea. *A*, Frontal view; *B*, lateral view; *C*, dorsal view of abdomen; *D*, antenna; *E*, first maxilliped; *F*, second maxilliped. Bar scale represents 1·0 mm for *D* and 2·0 mm for the remainder.

and carry more subsidiary spines. There are 4 spines on the antero-lateral margin of each telson fork as opposed to 2 in *R. benedicti*, and there is an extra pair of spines on the posterior carapace margin. All of these differences are probably specific rather than generic.

If the larva does belong to *Raninoides* then the known distributions of the adults (Table 1) indicate that it probably belongs either to *R. personatus* White or to *R. serratifrons* Henderson.

Raninid larva B

(fig. 4)

Material: One slightly damaged specimen, probably a third zoea. Position 06° 26'N: 49° 46'E; depth 200 m to surface. Date 17. VIII. 1964. Vessel *Argo;* Dodo cruise; Station 37. I.O.B.C. serial no. 0374.

Size: Carapace length from between the eyes to posterior carapace margin 1·83 mm; Abdomen length 2·71 mm; no spine tip to spine tip measurement can be given because the dorsal spine is broken.

Description: Carapace with long dorsal and rostral spines, and curved, forwardly directed lateral spines, each with a number of subsidiary spines. Anterior and posterior blunt dorsal tubercles in the mid-line. A supra-ocular spine present on the right-hand-side; the left-hand-side is damaged, but does not appear to have possessed a spine in this position. A number of spines on the carapace surface beneath the insertion of each lateral spine and on the slightly raised ridge between the dorsal and lateral spines. A series of spines on each postero-lateral carapace margin decreasing in size ventrally. Eyes free, with the stalks carrying many setae but no sign of papillae or spines. Whole surface of carapace covered with short setae (not shown in the illustrations).

Abdomen of 6 segments plus the telson. Segments 2–5 with long, acute spines on the postero-lateral corners. Segment 2 with forwardly directed lateral processes and segments 4 and 5 each with a median ventral spine. All abdominal segments with a number of other spines on the dorsal and lateral surfaces and also on the posterior margins; segments 1–5 have long setae on the posterior margins (fig. 4(C)).

Telson (fig. 4(C)) a broad flat plate, about 4 times as broad as its length in the mid-line. Posterior margin on the right-hand-side carries a large, fused spine, presumably representing the 4th telson process. Outside this large spine there are a very small and 2 larger fused spines which probably represent the first 3 telson processes, although the outer one is not clearly distinguishable from the series of spines on the antero-lateral telson margin. Postero-lateral region of the telson on the left-hand-side is damaged beyond the base of the main fused spine. Posterior margin with 21 articulated processes between the major spines. A series of small spines on the dorsal surface, close to the posterior margin, extends onto the main telson spines. Dorsal surface of telson and abdominal segments with many small setae.

Antennule simple and unsegmented, with 3–4 terminal aesthetascs and a single seta.

Antenna (fig. 4(D)) with 19–20 marginal setae on the scale and a series of small bristles on both the upper and lower surfaces. Endopod less than 1/3 length of

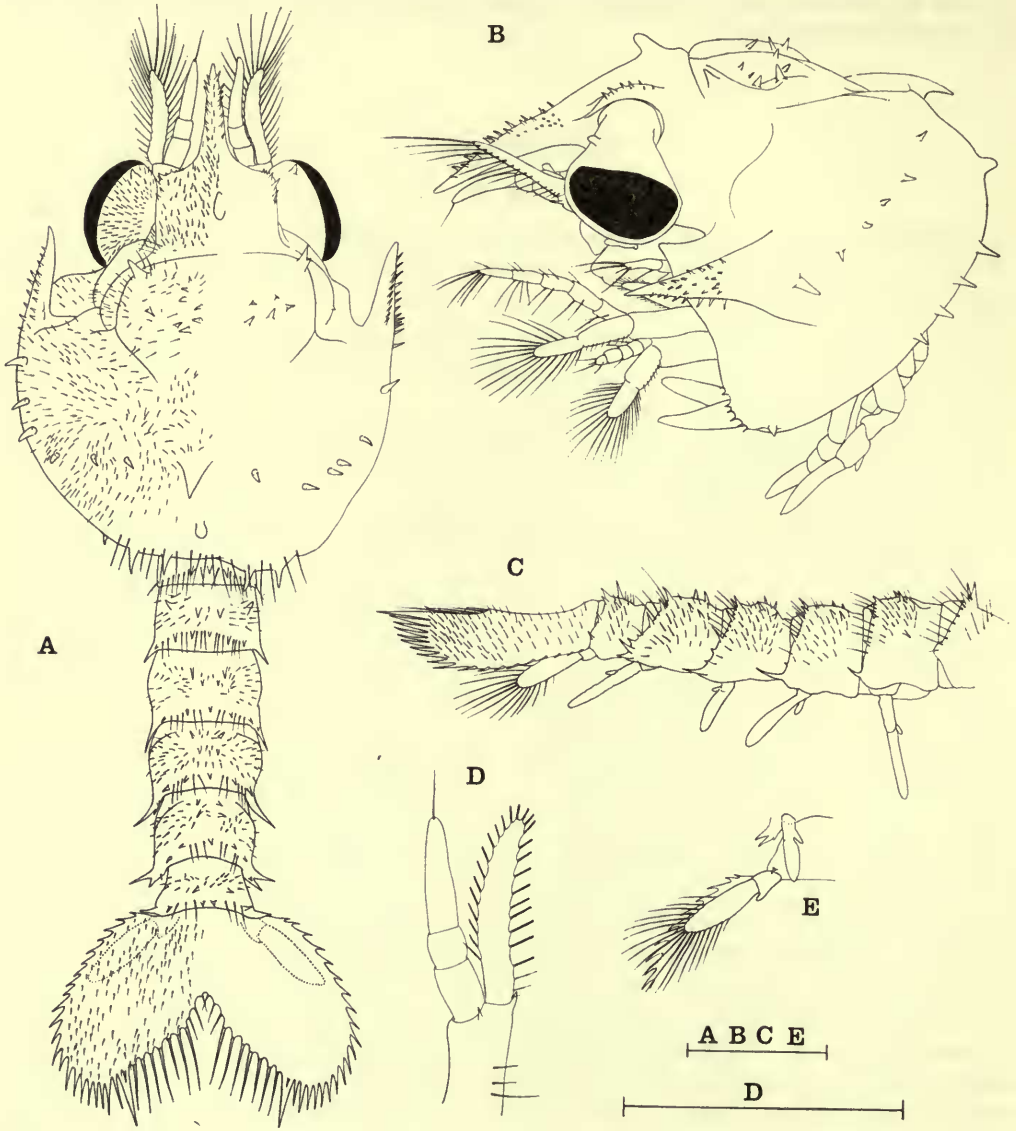

FIG. 5. Raninid larva C, terminal zoea. *A*, Dorsal view; *B*, lateral view of thorax; *C*, lateral view of abdomen; *D*, antenna; *E*, ventral view of last pleopod and uropod on the right-hand-side. The small surface setae have been omitted partly from *A* and wholly from *B*. Bar scales represent 1·0 mm.

scale, fused to basis and armed with a single terminal seta. Basis with spinous process about 1/3 length of scale, and a second prominent spine at the base of the scale.

Manbidle with no palp.

Maxillule with an unsegmented endopod armed with 4 setae. A single seta on the lateral margin of the basis below the endopod.

Maxillipeds 1 and 2 as shown in fig. 4(E and F). Exopod of maxilliped 1 with 11 or 12 natatory setae, that of maxilliped 2 with 13 setae on the distal half and 3 on the proximal half.

Maxilliped 3 and the more posterior thoracic appendages present as unarmed, unsegmented buds.

No pleopods present but the uropods have well developed exopods carrying 6 or 7 marginal setae. Endopods represented by very small unarmed buds not separated from the protopods.

Remarks: From the known development of *Lyreidus tridentatus* and *Raninoides benedicti* it is clear that the determination of the zoeal stage in raninid larvae is not as simple as it is, for example, in the higher Brachyura. However, from the presence in the above larva of well developed uropods but the absence of pleopods, and also the degree of development of the antennules, antennae and maxillipeds, it appears to be at about the mid-point of the zoeal series, perhaps the third or fourth of a total of about 6 zoeal stages.

Identification of this larva is also difficult. The differences between it and the known larvae of *Lyreidus* and *Raninoides* suggest that it belongs to a genus other than these. The changes which would be necessary to transform the first zoea of *Ranina ranina* into this larva, particularly in the armature of the carapace and the form of the telson, are greater than those ocurring during the development of *L. tridentatus* and *R. benedicti*, indicating that it does not belong to *R. ranina* either. This leaves the parentage still very uncertain, but probably among the genera *Cosmonotus*, *Notopus* and *Notosceles*.

Raninid larva C

(fig. 5)

Material: One specimen in the last zoeal stage. Position 09° 34′N: 75° 16′E; depth 200 m to surface. Date 10. II. 1965. Vessel *Meteor;* Station 187. I.O.B.C. serial no. 0145.

Size: Tip of rostral spine to tip of dorsal spine 3·8 mm; tip of rostral spine to posterior median carapace margin 3·9 mm; total length (tip of rostral spine to base of telson fork) 6·6 mm.

Description: Carapace with prominent forwardly directed rostral and paired lateral spines; subsidiary spines on the dorsal surface of the rostrum and on the outer surfaces of the laterals. Dorsal spine small, curving posteriorly. Blunt anterior and posterior carapace tubercles in the mid-line. Rostrum widens between the eyes to a front carrying a series of spines on each antero-lateral angle. A pair

of bulbous lobes behind the eyes each carrying a prominent spine antero-laterally and a number of smaller spines dorsally. A curving row of 6 spines on each side of the carapace between the bases of the lateral and dorsal spines. A parallel row of 4 spines close to the postero-lateral carapace margin. Each postero-ventral corner of the carapace with a single spine and a series of denticles. A prominent papilla on each eyestalk.

Abdomen (fig. 5(A and C)) of 6 segments plus the telson. First segment with a raised transverse ridge armed with a row of long plumose setae and with 3 spines close to the mid-line. Segments 2–5 all basically similar, having each postero-lateral margin produced into a long, slightly curved spine. A somewhat variable number of other spines on each segment, but a basic pattern of 4 on the dorsal surface anteriorly, and a series of 5 on the postero-dorsal margin. Segment 5 with additional spines, including a prominent one at each postero-lateral corner. Segment 6 with only 2 dorsal spines, but 6 spines on the posterior margin, the outer pair in dorsal view looking like the postero-lateral spines of the more anterior segments.

Telson (fig. 5(A)) a broad, bilobed plate. Each antero- and postero-lateral margin with a series of fused spines increasing in size gradually posteriorly, but ending in a much larger spine with a small spine basally on the dorsal surface. Posterior telson margin with 10 pairs of articulated processes between the telson forks, inner 3 pairs much smaller than the others and probably added at the most recent moult.

The whole of the dorsal surface of the carapace, abdomen and telson covered with short, close-set setae.

Antennule with an unsegmented peduncle, swollen basally and with an obvious statocyst. Endopod unarmed and not separated from the peduncle. Flagellum with 3 groups of about 3, 3, and 4 aesthetascs.

Antenna (fig. 5(D)) with 26–28 marginal setae on the scale. Endopod 3-segmented, about as long as scale and with a single terminal seta. Protopod with 2 spines and 3 setae.

Mandible with an unarmed, unsegmented palp.

Maxillule with 2-segmented endopod carrying 5 setae on the distal segment and a single seta on the proximal segment. Lateral margin of basis with a single seta.

Maxilla with more than 70 marginal setae on the scaphognathite. Unsegmented endopod with 6 terminal, 1 medial and 4 lateral setae.

Maxilliped 1 with 2-lobed epipod. Basipod with 15 setae on medial margin. The 5 segments of the endopod carry 3, 2, 2, 4 and 6 setae respectively on the medial margins. The lateral margins of segments 2 and 5 (terminal) each with a single fine seta, those of segments 3 and 4 each with 2 fine setae. Exopod 2-segmented; proximal segment with 8 setae along posterior edge, distal segment with 15 or 17 setae around whole margin.

Maxilliped 2 with simple epipod. Basipod with 4 setae on medial margin and 2 on posterior surface at the base of the endopod and exopod. Endopod on one side of 4 segments with 2, 1, 2 and 3 inner setae respectively. On the other side the long penultimate segment is sub-divided, the proximal part being unarmed. Terminal and sub-terminal segments each with a very fine lateral seta. Exopod 2-segmented;

proximal segment with 6 or 7 setae along posterior edge, distal segment with 21 marginal setae.

Maxilliped 3 with endopod indistinctly divided into 4 segments of which the terminal and sub-terminal each carry a short seta. Exopod short, simple and unarmed.

Pereiopods all present and indistinctly segmented, the first pair chelate.

Pleopods on abdominal segments 2–5 well developed but unsegmented, with small endopods and larger exopods (fig. 5 (C and E)). Exopods and endopods unarmed, but with somewhat serrate margins indicating that they would probably become setose at the next moult. Uropods with exopods separated from protopods and carrying 20–21 plumose setae. Endopods represented by small buds and not separated from the protopods (fig. 5(E)).

Remarks: Of the raninid larvae previously described, this zoea most closely resembles *Lithozoea serrulata* described by Aikawa (1933). The two larvae share a number of common features including the broad, plate-like telson, forwardly directed carapace spines, spine rows on the posterior carapace margin and on the side of the carapace between the lateral spines and the dorsal spine, and relatively short rostral and dorsal spines. The main differences between the larvae are the development of the anterior carapace tubercle into a bifurcated spine and the presence of lateral carapace keels in *Lithozoea*, the presence of a mandibular palp in the Indian Ocean larva and 4 ot 5 segments in the endopod of the second maxilliped in this larva compared with only 3 in *Lithozoea*.

Williamson (1965) pointed out that *Lithozoea serrulata* possesses a number of homolid characters, particularly in the carapace spines and keels. Although raninid larva *C* is somewhat less homolid in these respects than *Lithozoea*, it does resemble late homolid zoeae in having more than 3 segments in the endopod of the second maxilliped. No brachygnathan larvae have more than 3 segments in this endopod, and the only previously described raninid larva which may have more than 3 is *Acanthocaris* described by Claus (1876 and 1885) (see Williamson, 1965, p. 388), which also shows some homolid features in its carapace.

Little can be said about the identity of this Indian Ocean larva. As with the previous larva, comparison with published larval descriptions readily excludes it from the genera *Lyreidus*, *Ranina* and *Raninoides*. This still leaves as possible parents the genera *Notopus*, *Cosmonotus* and *Notosceles*, although adult *Notosceles* are so similar to *Raninoides* that they must surely have similar larvae. The similarities between the Indian Ocean larva and Aikawa's *Lithozoea serrulata* suggest that they belong to the same genus. If this is so, the Indian Ocean larva may belong to *Notopus dorsipes* (Fabr.) since, of the three genera deduced as possible parents, *Notopus* is the only one with different species recorded in Indian and Japanese waters. *N. dorsipes* is the only species known from the Indian Ocean, having been recorded by Alcock (1896) from off the Malabar coast, relatively close to where raninid larva *C* was collected, but two other species, *N. ovalis* Henderson and *N. misakiensis* Sakai are also recorded from Japan (Sakai, 1937). *Lithozoea serrulata* perhaps belongs to one of these species.

Raninid larva D; ?Raninoides sp.

(figs 6 and 7)

MATERIAL: One megalopa. Position 10° 36′N: 95° 39′E; depth 125 to 250 m. Date 25. III. 1963. Vessel *Anton Bruun;* cruise 1; Station 24 S.O.S.C. Acc. no. 3.

SIZE: Carapace length from tip of rostrum to posterior carapace margin 3·6 mm; Maximum carapace width 1·9 mm.

DESCRIPTION: The megalopa is fully illustrated in figs 6 and 7. It is very similar to the megalopa of *Raninoides benedicti* as described by Knight (1968) and therefore only the main differences between the two larvae will be mentioned here.

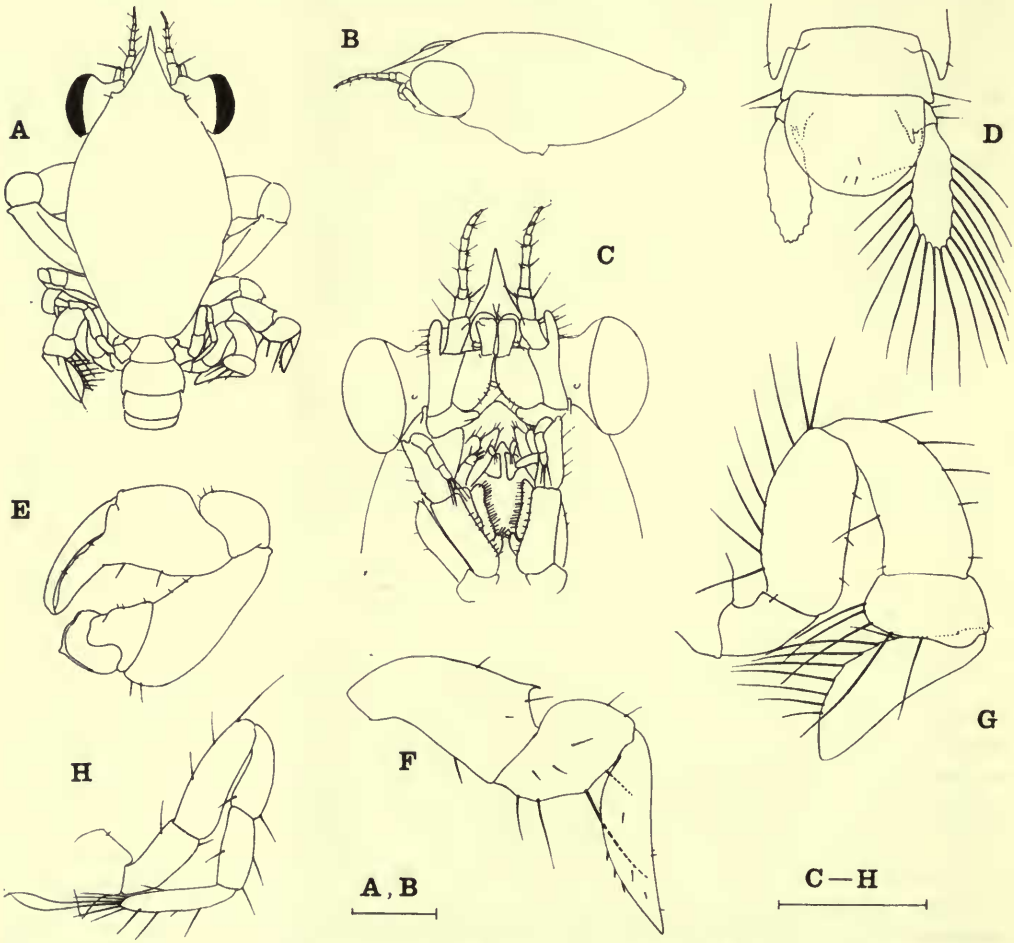

FIG. 6. Raninid larva D; *?Raninoides* megalopa. *A*, Dorsal view; *B*, lateral view of carapace; *C*, ventral view of anterior part of thorax; *D*, dorsal view of telson; *E*, cheliped, left-hand-side, ventral view; *F*, *G*, and *H*, third, fourth and fifth pereiopods respectively of the right-hand-side, dorsal views. Bar scales represent 1·0 mm for *A*, *B*, *C* and *E*, and 0·5 mm for *D*, *F*, *G* and *H*.

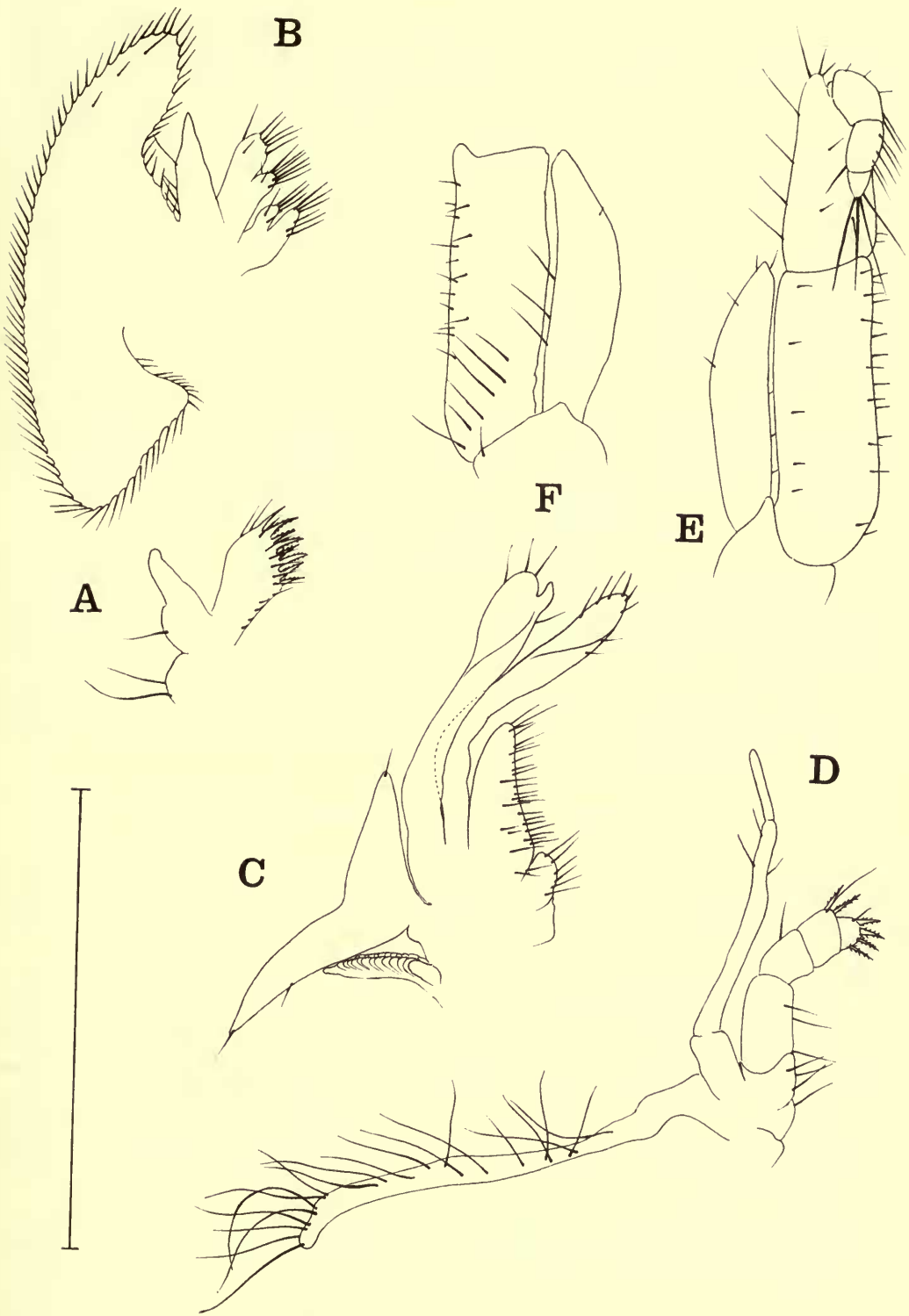

FIG. 7. Raninid larva D; ?*Raninoides* megalopa. *A*, Maxillule; *B*, maxilla; *C*, *D* and *E*, first, second and third maxillipeds in ventral view; *F*, ischium and exopod of third maxilliped in dorsal view. Bar scale represents 1·0 mm.

The carapace is slightly narrower posteriorly than is that of *R. benedicti*. The eyestalk papillae are placed postero-ventrally rather than antero-dorsally as in *R. benedicti*. The large spine between the bases of the chelipeds in *R. benedicti* is absent. The Indian Ocean megalopa has no podobranch on the second maxilliped, while the ischium of the third maxilliped (fig. 7(E and F)) is relatively longer than in *R. benedicti* and has no teeth on the inner margin.

The chelipeds and the second and third legs in *R. benedicti* each have a prominent spine on the ventral margin of the merus; the Indian Ocean megalopa lacks these spines but has a spine on the dorsal margin of the carpus of legs two and three. (These two legs are very similar, and therefore only leg three is illustrated in fig. 6.) The fourth and fifth legs are very similar in shape in the two larvae, but the fourth leg in the Indian Ocean specimen carries many more setae and the dactyl is less acutely pointed than in *R. benedicti*.

Remarks: The similarity between this larva and the known megalopa of *Raninoides benedicti* indicates that it belongs to the same genus. From the locality of capture of the larva and the known distributions of the adults, *Raninoides hendersoni* Chopra and *R. serratifrons* Henderson are equally likely to be the parent.

Family **HOMOLIDAE**

Plankton-caught larvae of the Homolidae present very much the same problems of identification as do those of the Raninidae, since larvae have been hatched from only four species and the complete larval development is known for only one of these (see Williamson, 1965 and Rice and Provenzano, 1970).

The I.I.O.E. collections contain only two homolid zoeae, neither of them agreeing with any previously described larvae.

Homolid larva A ?Homola sp.

(fig. 8)

Material: One specimen, probably a second zoea. Position 11° 49′S: 49° 23′E. Date 21. VII. 1964. Vessel *R.R.S. Discovery;* Station 5508. I.O.B.C. serial no. 1517.

Size: Carapace length from tip of rostrum to posterior margin in mid-line 1·4 mm; Total length from tip of rostrum to posterior margin of telson in mid-line 2·5 mm.

Description: The main features of the morphology of this larva are adequately shown in the illustrations. This description will therefore be restricted to those features which are not illustrated but which can be seen without dissection.

Antennule 2-segmented. Distal segment with 3 or 4 aesthetascs and setae; proximal segment with a long median seta, representing the inner flagellum, and a row of 3 short setae.

Mandibles without palps.

Maxilla with about 18 marginal setae on the scaphognathite.

Maxilliped 1 as shown in fig. 8 (D).

Maxilliped 2 with the 4 segments of the endopod carrying 1, 1, 2 and 5 setae respectively, one seta on the terminal segment being laterally placed. Basis with 5 medial setae and the exopod with 7 natatory setae.

Maxilliped 3 with an unsegmented endopod carrying a single terminal seta. Exopod with 7 setae.

Posterior thoracic appendages represented by unarmed, unsegmented buds.

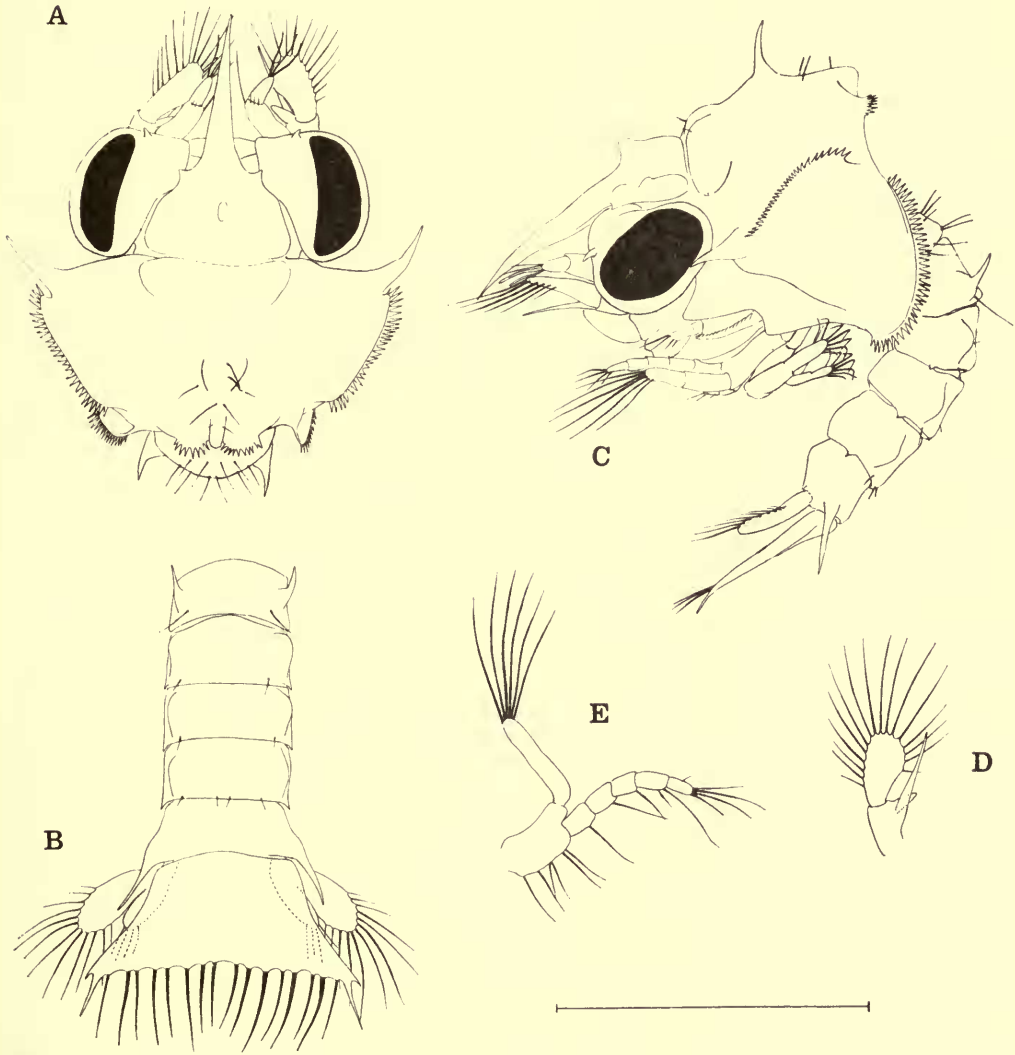

FIG. 8. Homolid larva A, stage II zoea. *A*, Dorsal view of carapace; B, dorsal view of abdomen; C, lateral view; D, antenna; E, first maxilliped. Bar scale represents 1.0 mm.

Remarks: In general form this larva is very similar to the larvae of *Homola barbata* (Fabr.) described from Florida by Rice and Provenzano (1970), and also to the series of larvae taken in the plankton off South Africa and attributed to a species of *Homola* by Rice and von Levetzow (1967). However, the present specimen differs from these previously described forms in several important respects.

The supra-ocular spines and the anterior and posterior carapace tubercles, which are very prominent in the Florida and South African larvae, are much reduced in the Indian Ocean specimen. This larva also has the anterior end of the dorsal tooth row on the carapace less protruberant than in the other larvae, and less likely to be replaced by a spine in the later stages.

The dorsal spines on abdominal segments 2–5 in the Florida and South African larvae are entirely lacking in this specimen and, except for the second segment, the dorso-lateral spines are reduced to blunt protruberances. The Indian Ocean larva also lacks spines on the dorsal surface of the telson.

Finally, in its degree of development this larva does not agree precisely with any stage in either of the previously described series, falling between the second and third stage in both cases.

The absence of dorsal telson spines in two ?*Homola* larvae from off south-east Africa described by Boas (1880) suggested to Rice and von Levetzow that these larvae were specifically distinct from their own South African material. From the known distributions of the adults these authors suggested that Boas's larvae might represent *Homola orientalis* Henderson, while their own material belonged to the eastern Atlantic and South African form of *H. barbata*.

The larvae described here also lacks dorsal telson spines, like Boas's larvae, but differs from them in having reduced supra-ocular spines. Boas's larvae also have a pair of dorso-lateral carapace spines, presumably developed from the anterior end of the dorsal carapace tooth row of an earlier stage; as noted above, such spines are unlikely to be developed in a later stage of the I.I.O.E. larva. If these differences are specific, then there is either a third, unsuspected, species of *Homola* in the south-western Indian Ocean, or else at least some of the larvae attributed to *Homola* in fact belong to a different genus.

Knowledge of generic differences between homolid larvae is restricted to a comparison of hatched larvae of *Homola barbata* (Fabr.) (Rice and Provenzano, 1970), *Paromola japonica* Parisi and *Latreillia phalangium* de Haan (Aikawa, 1937) and *Latreillia australiensis* Henderson (Williamson, 1965). Williamson noted that the homolid larvae described up to that time (1965) fell into two groups, one of which, including the hatched larvae of *Latreillia* and *Paromola*, differed from the second group in having neither dorsal nor antero-lateral carapace spines and no dorsal spines on the abdomen. Williamson suggested that these groups probably did not represent taxonomic groupings within the family and that intermediate forms would probably be found as more homolid larvae were described.

The larva described here agrees most closely with the second of these larval groups, which includes not only the larvae described by Rice and von Levetzow (1967), Rice and Provenzano (1970) and Boas (1880), but also Gurney's (1924) Dromiacean species I and specimens attributed to the genus *Homola* by Cano (1893),

Thiele (1905), Pike and Williamson (1960) and Rice (1964). However, it differs from all of these forms in the absence of mid-dorsal spines on the abdominal segments and is therefore intermediate between Williamson's two groups. Considering the great similarity between the known larvae of *Latreillia* and *Paromola*, generic differences between homolid larvae seem to be very slight so that this larva may, indeed, belong to a genus other than *Homola*.

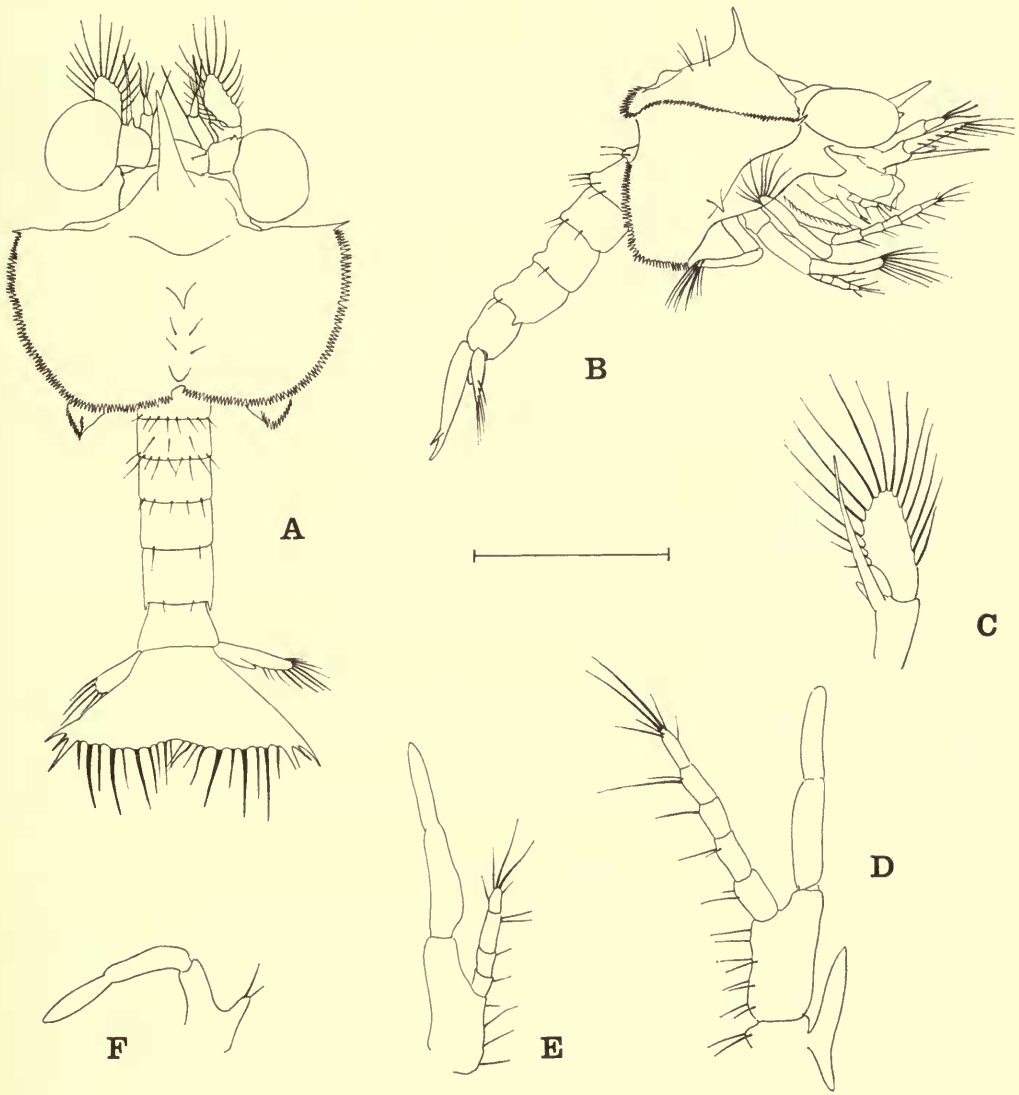

FIG. 9. Homolid larva B, stage III zoea. *A*, Dorsal view; *B*, lateral view; *C*, antenna; *D*, *E* and *F*, first, second and third maxillipeds. Bar scale represents 1·0 mm for *A* and *B*, and 0·5 mm for *C*, *D*, *E* and *F*.

Homolid larva B

(fig. 9)

MATERIAL: One specimen, probably a third zoea. Position 16° 31′N: 54° 08′E. Date 30. VI. 1963. Vessel *R.R.S. Discovery:* Station 5026. I.O.B.C. serial no. 0811.

SIZE: Carapace length from tip of rostrum to posterior margin in mid-line 1·5 mm. Total length from tip of rostrum to posterior margin of telson in mid-line 3·3 mm.

DESCRIPTION: Carapace with a forwardly directed and somewhat upturned rostrum. Prominent mid-dorsal spine and smaller posterior carapace tubercle; no anterior tubercle. Dorsal tooth row of 70–80 teeth on each side, extending from middle of posterior margin to behind the eye and ending in a rather longer and stouter tooth. Postero-ventral tooth row of 50–60 sub-equal teeth. A prominent ventro-lateral spine on each side of the carapace above the base of the third maxilliped. Prominent eyestalk papillae.

Abdomen of 6 segments and telson. Segment 2 with slight dorsal transverse ridge and segment 5 with small postero-lateral processes; otherwise all abdominal segments simple and unarmed apart from some setae close to posterior margins.

Telson a broad, triangular plate, with 3 fused spines at each postero-lateral angle and 10 pairs of processes articulated to posterior margin. Uropods with protopods not separated from endopods and exopods. Endopods unarmed, exopods with 9–11 marginal setae.

Antennule 2-segmented, proximal segment with a single long plumose seta representing ventral flagellum, distal segment with 2 terminal aesthetascs and 2 setae.

Antenna (fig. 9(C)) with 16 marginal setae on scale, spinous process about 1·5 times length of scale, endopod unarmed and less than half length of scale.

Mandibles without palps.

Maxillule with 5 setae on distal segment of endopod and a single seta on proximal segment; no lateral seta on basis.

Maxilla with about 40 setae on scaphognathite.

Maxillipeds as illustrated in figs 9 (D, E, and F); exopods of each with 8 natatory setae.

Posterior thoracic appendages present as unarmed, unsegmented buds.

REMARKS: Like the preceding larva, this specimen is intermediate between the two homolid larval groups noted by Williamson. Thus, although it possesses the prominent dorsal carapace spine of the '*Homola*' group, it lacks the dorsal abdominal spines typical of most of these larvae. It is even less *Homola*-like than the larva described above since it also lacks any suggestion of supra-ocular spines, it has very small antero-laterals (if, indeed, the enlarged teeth at the anterior end of the dorsal carapace tooth rows represent these), and it has no dorso-lateral projections on the abdominal segments. The combination of characters is so different in this larva from that in any previously described zoea that its identity cannot be established at present.

DISCUSSION

The small collection of raninid and homolid larvae reported here tends to confirm Williamson's (1965) conclusions that the similarities between the two groups are consistent with both families being fairly close to a pre-brachyuran stock, the raninids being considerably more 'brachyuran' than the homolids.

Perhaps the most interesting larva in the collection is that described as raninid larva *C* which, like Aikawa's *Lithozoea serrulata*, is intermediate in many features between the homolids and the typical raninid larvae. Williamson noted that *L. serrulata* represents a possible intermediate step in the simplification of the rather complex carapace armature of the homolids towards the dorsal, rostral and lateral spines of the carapace in typical raninid and brachygnathan zoeae. Raninid larva *C* seems to be a further step in this direction, since the homolid denticulate carapace-folds, still present in *L. serrulata*, are represented only by a series of short spines in this larva. The relationship of the lateral carapace spines to the carapace folds and denticle rows in raninid larva *C* and *L. serrulata* indicate that the lateral spines in the raninids, and presumably also in the higher Brachyura, are homologous with either the antero-lateral spines in the homolids or, more probably, with the spines developed from the anterior ends of the dorsal denticle rows.

The bilobed, plate-like telsons of *L. serrulata* and raninid larva *C* also conveniently bridge the gap between the rather anomuran broad triangular telsons of late homolid zoeae and the forked telsons of the zoeae of *Ranina*, *Raninoides* and *Lyreidus*, which are more similar to those of typical brachyuran zoeae.

It would be interesting to know if these seemingly primitive raninid larvae belong to species with similarly primitive adults, but such information can come only from the rearing work which is much needed in both the Homolidae and the Raninidae.

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